WHAT IS CLAIMED IS:

1. A motor control device comprising rectifying devices and switching devices for three phases, which are connected between a DC power source and armature coils of an AC motor operatively coupled to an internal combustion engine,

said motor control device having the inverter function of converting a DC power from said DC power source into an AC power and supplying the AC power to said armature coils, and the converter function of converting an AC power generated by said AC motor into a DC power and supplying the DC power to said DC power source,

wherein rectangular-wave driving control of applying rectangular wave voltages to said armature coils of said AC motor is performed when said AC motor is operated for power running, and synchronous rectification control for making synchronous rectification of the AC power generated by said AC motor is performed when said AC motor is operated for electricity generation.

2. A motor control device according to Claim 1, wherein when the rectangular wave voltages are applied to said armature coils in the rectangular-wave driving control, currents flowing through said switching devices are held below maximum allowable current values of said switching devices.

3. A motor control device according to Claim 2, wherein pulse widths of the rectangular wave voltages applied to said armature coils are set such that the currents flowing through said switching devices are held below the maximum allowable current values of said switching devices.

4. A motor control device according to Claim 2, wherein resistance values of said armature coils are set such that the currents flowing through said switching devices are held below the maximum allowable current values of said switching devices.

5. A motor control device according to Claim 1, wherein, in the rectangular-wave driving control, pulse widths of the rectangular wave voltages applied to said armature coils are set such that each pulse width is equal to a half cycle (180°) of an electrical angle of said AC motor at maximum and gradually decreases as a rotation speed of said AC motor lowers.

6. A motor control device according to Claim 1, wherein, in the rectangular-wave driving control, pulse widths of the rectangular wave voltages applied to said armature coils are set such that each pulse width is equal to a half cycle (180°) of an electrical angle of said AC motor at maximum and gradually decreases as a voltage of said AC motor lowers.

7. A motor control device according to Claim 6, wherein, in the rectangular-wave driving control, the pulse widths of the rectangular wave voltages applied to said armature coils are set such that, when a voltage of said DC power source is relatively high, currents flowing through said switching devices are held below the maximum allowable current values of said switching devices.

8. A motor control device according to Claim 1, wherein, in the rectangular-wave driving control, pulse widths of the rectangular wave voltages applied to said armature coils are set such that each pulse width is equal to a half cycle (180°) of an electrical angle of said AC motor at maximum and gradually decrease as temperatures of said armature coils or temperatures of said switching devices rise.

9. A motor control device according to Claim 8, wherein, in the rectangular-wave driving control, the pulse widths of the rectangular wave voltages applied to said armature coils are set such that, when temperatures of said armature coils or temperatures of said switching devices are relatively high, currents flowing through said switching devices are held below the allowable temperatures of said armature coils or said switching devices.

10. A motor control device according to Claim 1, wherein the power running under the rectangular-wave driving

control is performed when the rotation speed of said AC motor lowers is lower than a predetermined speed, and the electricity generation under the synchronous rectification control is performed when the rotation speed of said AC motor lowers is higher than the predetermined speed.

11. A motor control device according to Claim 1, wherein the power running under the rectangular-wave driving control is performed when a predetermined time has not yet lapsed from start of operation of said internal combustion engine, and electricity generation under the synchronous rectification control is performed when the predetermined time has lapsed from start of operation of said internal combustion engine.

12. A motor control device for performing power running control and electricity generation control on an AC motor connected to an internal combustion engine, said motor control device comprising:

a power module including rectifying devices and switching devices, and having the inverter function of converting a direct current into an alternating current and the converter function of converting an alternating current into a direct current;

a power-running/electricity-generation changing-over unit for changing over the power running control and the electricity generation control to be performed on said AC motor; and

a power running control unit for performing the power running control on said AC motor when the power running control is selected by said power-running/electricity-generation changing-over unit,

said power running control unit comprising:

a magnetic pole position detecting unit for detecting a magnetic pole position or an electrical angle of said AC motor;

a speed computing unit for computing a rotation speed ω of said AC motor;

an interlinkage magnetic-flux amount computing unit for computing an amount of magnetic flux ϕ interlinking with armature coils of a stator of said AC motor;

a voltage vector phase computing unit for computing a phase θv of a voltage vector V applied to the armature coil of the stator of said AC motor; and

a pulse generating unit for generating a switching signal applied to the switching device of said power module,

thereby performing rectangular-wave driving control on said AC motor in a power running mode.

13. A motor control device for performing power running control and electricity generation control on an AC motor connected to an internal combustion engine, said motor control device comprising:

a power module including rectifying devices and switching devices, and having the inverter function of converting a direct current into an alternating current and

the converter function of converting an alternating current into a direct current;

a power-running/electricity-generation changing-over unit for changing over the power running control and the electricity generation control to be performed on said AC motor; and

an electricity generation control unit for performing the electricity generation control on said AC motor when the electricity generation control is selected by said power-running/electricity-generation changing-over unit,

said electricity generation control unit comprising:

a magnetic pole position detecting unit for detecting a magnetic pole position or an electrical angle of said AC motor;

a speed computing unit for computing a rotation speed ω of said AC motor;

an interlinkage magnetic-flux amount computing unit for computing an amount of magnetic flux ϕ interlinking with armature coils of a stator of said AC motor;

an induced voltage computing unit for computing induced voltages Vue, Vve and Vwe of respective phases in the armature coils of said rotor of said AC motor;

a DC voltage detecting unit for detecting a voltage VB of a DC power source connected to said power module;

a voltage comparing unit for comparing inter-line values of the induced voltages Vue, Vve and Vwe with the voltage VB of said DC power source;

a pulse cycle computing unit for computing a pulse

cycle of a switching signal applied to the switching device of said power module based on a result of the comparison made by said voltage comparing unit; and

a pulse generating unit for generating the switching signal applied to the switching device of said power module based on the pulse cycle computed by said pulse cycle computing unit,

thereby performing synchronous rectification control on said AC motor in an electricity generation mode.

14. A motor control device according to Claim 13, wherein the induced voltages generated in said AC motor when said internal combustion engine is running at idle is higher than the voltage of said DC power source.

15. A motor control device comprising:

upper arm driving means for receiving a power-running or rectification mode command, selecting an upper-arm power running drive signal or an upper-arm rectification drive signal in response to the power-running or rectification mode command, and outputting the upper-arm power running drive signal or the upper-arm rectification drive signal to a control terminal of an upper-arm switching device;

lower arm driving means for receiving a power-running or rectification mode command, selecting a lower-arm power running drive signal or a lower-arm rectification drive signal in response to the power-running or rectification mode command, and outputting the lower-arm power running

drive signal or the lower-arm rectification drive signal to a control terminal of a lower-arm switching device;

phase-correction drive signal distributing means for receiving a magnetic pole position detected signal from an AC motor, advancing a phase of the magnetic pole position detected signal depending on a rotation speed of said AC motor, and distributing the magnetic pole position detected signal having the advanced phase as the upper-arm power running drive signal and the lower-arm power running drive signal, the upper-arm power running drive signal being outputted to said upper arm driving means and the lower-arm power running drive signal being outputted to said lower arm driving meaps;

upper-arm rectification detecting means for comparing the magnitude of a potential at a higher potential terminal for a main power source with the magnitude of a potential at an output terminal, and outputting the upper-arm rectification drive signal to said upper arm driving means when the magnitude of the potential at the output terminal is larger; and

lower-arm rectification detecting means for comparing the magnitude of the potential at the output terminal with the magnitude of a potential at a lower potential terminal for said main power source, and outputting the lower-arm rectification drive signal to said lower arm driving means when the magnitude of the potential at the output terminal is smaller.

16. A motor control device according to Claim 15, wherein said phase-correction drive signal distributing means comprises:

a frequency-voltage conversion circuit for receiving the magnetic pole position detected signal from said AC motor and converting rotation frequency of said AC motor into a DC voltage;

a constant current source having a current value changed depending on an output voltage of said frequency-voltage conversion circuit;

triangular wave generating means for generating a triangular wave with a constant current supplied from said constant current source;

a capacity charging switch for delivering the current from said constant current source to said triangular wave generating means;

a capacity discharging switch for drawing the current from said triangular wave generating means into said constant current source;

a voltage comparator for comparing the triangular wave outputted from said triangular wave generating means with a reference voltage, and generating a voltage pulse;

a drive signal distribution circuit for distributing the voltage pulse outputted from said voltage comparator as the upper-arm power running drive signal with the potential at the lower potential terminal for said main power source being a reference, and as lower-arm power running drive signal with the potential at the lower potential terminal

for said main power source being a reference, the lower-arm power running drive signal being outputted to said lower arm driving means; and

a level shift-up circuit for converting the reference potential of the upper-arm power running drive signal from the potential at the lower potential terminal for said main power source into a potential at an output terminal, and outputting the converted potential to said upper arm driving means.

17. A motor control device according to Claim 15, wherein said upper-arm rectification detecting means comprises:

negative voltage detecting means for receiving the potential at the higher potential terminal for said main power source and the potential at the output terminal, outputting a negative voltage to the output terminal when the magnitude of the potential at the output terminal is larger, and outputting a positive voltage to the output terminal when the magnitude of the potential at the output terminal is smaller; and

amplifying means for amplifying a voltage level when said negative voltage detecting means outputs a negative voltage, and

wherein said lower-arm rectification detecting means comprises:

negative voltage detecting means for receiving the potential at the output terminal and the potential at the

lower potential terminal for said main power source, outputting a negative voltage to the lower potential terminal for said main power source when the magnitude of the potential at the output terminal is smaller, and outputting a positive voltage to the output terminal when the magnitude of the potential at the output terminal is smaller; and

amplifying means for amplifying a voltage level when said negative voltage detecting means outputs a negative voltage.

18. A motor control device according to Claim 15, further comprising:

an upper arm switching device having a drain connected to the higher potential terminal for said main power source and having a source connected to the output terminal; and

a lower arm switching device having a drain connected to the output terminal and having a source connected to the lower potential terminal for said main power source.